High-performance removal of 2,4-dichlorophenoxyacetic acid herbicide in water using activated carbon derived from Queen palm fruit endocarp (*Syagrus romanzoffiana*)

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Abstract

In this work, an activated carbon sample with a high adsorptive performance for the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) was prepared from queen palm endocarp (*Syagrus romanzoffiana*) by pyrolysis process. The activated carbon presented an XRD pattern related to carbon graphite and functional groups such as C–H, C=O, O–H. The material particles presented a highly-porous structure, being beneficial to the adsorption process. The activated carbon showed a remarkable specific surface area of 782 $m^2\ g^{-1}$ and pore volume of 0.441 $cm^3\ g^{-1}$. The solution pH presented a strong influence on the adsorption process, with ideal pH = 2, being the best adsorbent dosage, 0.5 g L^{-1}. The correspondent removal percentage was 95.4%. The pseudo-second-order model represented kinetic data, presenting $R^2 > 0.992$ and MSR< 19.62 $(mg\ g^{-1})^2$. The Langmuir model was the most suitable for describing the equilibrium data with the highest R^2 (> 0.997) and lowest values of MSR (< 92.04 $(mg\ g^{-1})^2$), indicating a maximum capacity of 367.77 mg g^{-1}. The thermodynamic study indicated a spontaneous operation, with ΔG^o ranging from −23.2 to −32.6 kJ mol^{-1} and endothermic process (ΔH^o = 67.30 kJ mol^{-1}), involving physical interactions in the adsorbent/adsorbate system. The adsorbent could be regenerated by NaOH and used 7 times with the same adsorption capacity. Hence, overall, the activated carbon prepared from the Jerivá endocarp corresponds to a promising adsorbent in removing 2,4-D herbicide in wastewater.

Keywords
Activated carbón; *Syagrus romanzoffiana;* Queen palm; 2,4-D, adsorption